Volume 8 Issue 5 (2024) Pages 1121-1136
Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini
ISSN: 2549-8959 (Online) 2356-1327 (Print)

Geometry Learning Design Through Ethnomathematics of Gandrung Fashion and Accessories

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DOI: [10.31004/obsesi.v8i5.5846](https://doi.org/10.31004/obsesi.v8i5.5846)

Abstract

This study aims to describe students' exploration activities regarding Ethnomathematics using student worksheets with the RME approach. This study is a design study designed through the inherent assumptions of the learning trajectory hypothesis analysis framework (HLT), which is then tested in realistic mathematics education (RME). Gandrung is a traditional dance from Banyuwangi. Through Gandrung clothing and accessories, students can learn basic geometry. The design of this study was carried out in three stages, namely, initial design, experimental learning consisting of 2 cycles, and the third stage of analysis, namely retrospective. This study used a sample of 28 second-grade students in the Surabaya area, comprising six students in Cycle I and 22 in Cycle II. Students conducted the study's results to understand the concept of geometry and show that measurements can trigger the occurrence of a learning trajectory. The impact on students can be seen at the learning stage: observing certain parts of the picture, paying attention to exciting patterns/decorations, and aligning parts of the image. Students can simply conclude the results of the formation of basic concepts of flat plane geometry and its transformations.

Keywords: *HLT; Realistic Mathematics Education; Infatuated.*

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Received 16 December 2023, Accepted 9 October 2024, Published 17 October 2024

Introduction

In the ongoing reform, mathematics education plays an important role. Mathematics is considered the "Queen of Science", which means queen of science because it is the basic science of other structured and organized sciences (Salasari, 2019). At every level of school, the purpose of learning mathematics requires students to think creatively and logically and solve problems related to real life. Mathematics can help students face real-life situations (Ardiyani & Gunarhadi, 2018).

The broad conceptualization of mathematics allows the identification of several mathematical practices of all culturally identifiable groups with specific jargon, codes, symbols, myths, and even ways of thinking and inferring (Ambrosio, 1985). Of course, this stems from the concept of culture as the result of a hierarchy of behaviors, from individual behavior through social behavior to cultural behavior. This is based on the Cycle: reality – individual – real action – reality.

Realistic mathematics education has been widely and effectively implemented in several countries, such as the Netherlands, France, America, Indonesia, and others (Trung et

DOI: 10.31004/obsesi.v8i5.5846

al., 2019). Ethnomathematics is a breakthrough for us to further explore the diversity of local cultures in Indonesia. RME is an approach that is oriented towards human activities by providing students with the opportunity to discover concepts based on their experiences in the real world (Kamsurya, 2019). Learning with a realistic mathematics approach begins with appreciating and understanding the importance of mathematics as a human activity, which ultimately reaches the formal stage (Putu Wulan Pratami Dewi & Ngurah Sastra Agustika, 2020). The learning process is carried out in stages: the iceberg thinking stage, the fundamental stage through the initial mathematical knowledge that students already have, then presenting problems and results obtained through vertical and horizontal mathematical processes called progressive mathematics (Nuraida & Amam, 2019).

Students find it difficult to understand the concept of geometry and measurement because their learning experience still needs to be improved in relation to real life and visualization of geometric shapes (Rahmani, 2018). Students will better understand a concept if they are involved in learning activities that prioritize creativity, motor activity, and fast thinking. This is in line with the philosophy of Realistic Mathematics Education (RME) which is rooted in Frudenthal's interpretation, where mathematical material is a human activity (Irdawati et al., 2019). Therefore, teacher competence must be able to develop meaningful learning by involving students actively and realistically through Ethnomathematics (Verner et al., 2019).

One of the approaches to learning mathematics that is oriented towards mathematizing everyday experiences is Indonesian Realistic Mathematics Education (PMRI) (Pandi Putra Tihuri et al., 2018). The PMRI approach is developed from concrete things to abstract things, and student activities and responses are carried out through teaching aids. Teaching aids can be a bridge for students in the process of abstraction from simple things to formal knowledge by students themselves. Teaching aids that can be used as a bridge through the PMRI approach are the surrounding culture in Indonesia, such as the Gandrung dance culture in Banyuwangi.

Gandrung is the mascot of Banyuwangi City in the form of a traditional dance. This gandrung dance is performed as a welcoming dance at the opening of an event. In the gandrung performance there are various supporting parts such as accompanying musical instruments, make-up, clothing, and accessories worn by the gandrung dancers. One of the ethnomathematic studies conducted is the ethnomathematic study of Banyuwangi angklung paglak which states that the mathematical concepts that can be determined from the angklung paglak include (1) the concept of two or three-dimensional geometric shapes, (2) the concept of customary units of measurement, (3) the concept of measurement equations, (4) the concept of combinations (Hidayatulloh & Mirza Hariastuti, 2018).

Teaching basic mathematical concepts must be carried out properly and correctly to avoid further misunderstanding of mathematical concepts, especially for elementary school students, so student worksheets are needed to support teaching (Cinda Hendriana, 2020). We can learn examples of introducing various types of mathematics through culture through the Ethnomathematics of traditional Banyuwangi musical instruments as student teaching materials (Febri Andarini et al., 2019). Other research on fractal geometry to redesign Banyuwangi's Gajah Oling batik produces new designs that can enrich the diversity of its batik motifs (Agustina et al., 2016). Ethnomathematics in the floor pattern of the Banyuwangi Gandrung Dor dance can also be studied in relation to the concepts of planes and geometry. This is very helpful in understanding the concepts of planes and geometry through local culture (Rahmadani & Wahyuni, 2023).

The study “Exploration of Ethnomathematics of Gandrung Dance Costumes in Banyumas Regency as Geometry Teaching Materials” by (Eka Apriliana, 2022) discusses the part of mathematics that can be learned through culture. This study found that the shapes and motifs found in Gandrung Dance costumes have mathematical elements, including prime numbers, lines, plane shapes, similarity, and congruence. Not only that, this study also uses

DOI: 10.31004/obsesi.v8i5.5846

mathematical material through culture as teaching materials in the form of a summary of student worksheets.

Therefore, this research article is intended to support previous research. The research was conducted with different research subjects, different student characteristics, and different levels of material introduced. The importance of foundations in mathematics must also be built from the bottom up. This is important to strengthen the introduction of geometry in children, especially during the concrete operational period (Septiari, 2018). The benefits of introducing geometry to children are (1) being able to recognize basic flat shapes such as rectangles, circles, squares, and triangles, (2) children can distinguish shapes, (3) being able to group objects according to their size and shape, (4) children will provide an understanding of space, shape, and size (Rachmat & Sumiati, nd). The interrelated concepts of geometry and function can build a general concept of transformation geometry, so that to strengthen students' basic knowledge of more difficult material, the level of understanding needs to be introduced as early as possible so that teachers can try other methods or alternatives that allow learning to strengthen understanding of geometric concepts (Winanto, 2022).

Initial introduction through concrete objects is very important in implementing ethnomathematics learning activities. This study focuses on the clothing and accessories worn by gandrung dancers as teaching materials, which will later be implemented as HLT through student worksheets because the use of student worksheets will be more practical and can facilitate students in the learning process through the PMRI approach (Alamsyah et al., 2021). Learning through ethnomathematics student worksheets will be more effective because this learning uses a real-world context (Basuki & Wijaya, 2019).

Methodology

This research was conducted using a qualitative descriptive method with two cycles. The first research cycle was conducted at SDN Gading 1 Surabaya, and the second cycle was conducted at SDN Lidah Kulon 3, with the subjects of the 2nd grade of elementary school. In Cycle I, the subjects studied were 6 students, and in Cycle II, the subjects studied were 22 students. The selection of samples was based on certain criteria; in cycle I, the number of small-scale trial samples was selected to identify and obtain helpful feedback during revisions before large-scale testing. In addition, the criteria were determined for 6 students with learning ability levels with 3 categories, namely low, medium, high. Then in cycle II, the selection of samples was based on existing class samples (purposive *sampling)* because of the researcher's considerations and was considered representative.

For research, refer to the design research stages from Gravemeijer & Cobb, including (1) preparing the experiment or initial design, (2) carrying out the design experiment or teaching an experiment, and (3) reviewing the data analysis or analysis obtained from the previous stage (retrospective analysis) (Safaredha, 2014).

Based on the characteristics of the research design, this study aims to provide reasonable considerations during the learning process and obtain empirical learning theories (Haqq, 2020). Because the theory developed is empirical, the theory built is sourced from local learning theories that provide general answers to the topics taught (Warsito et al., 2019). Meanwhile, the acquisition of local learning theories arises from the cyclical learning design process, so the HLT results remain HLT (alleged local learning theory). The scheme of the stages of this design research is clearly illustrated in the following figure (Gravemeijer, 2004).

At this stage, analysis and design of the hypothesis learning pathway (HLT) is carried out on the topic of Measurement Geometry, where students can construct formal knowledge sourced from informal knowledge and built gradually through the mathematical process (Fauzan et al., 2020).

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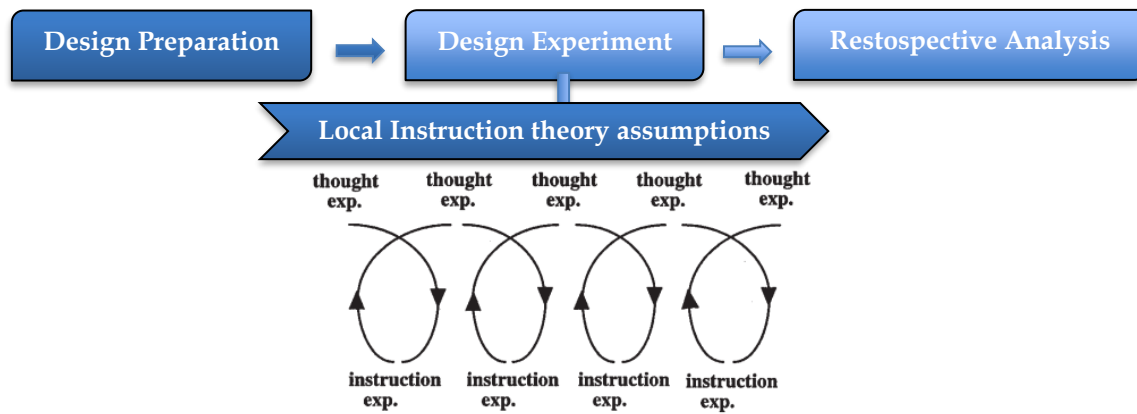
Figure 1. Research Design Cycle

Source analysis is obtained from a literature review, including previous research results, analysis of student learning barriers on geometry and measurement topics, observation of early grade student characteristics, interviews and discussions with homeroom teachers, and discussions with experts before and during the process of designing activities and learning activities to be carried out. The results of this HLT analysis are then presented in the HLT table as presented in Table 1.

Table 1. Learning Trajectory Hypothesis Analysis (HLT 1)

Activity	Learning objectives	Activity Description	Alleged Student Thinking
Situational (Concrete image presentation)	Explaining geometric shapes through culture	Students observe the images presented and think about the surrounding culture.	Students listen and think and mention examples of culture.
Model From (Formation of a scheme by grouping parts of an image that resemble the concept of geometric transformation)	Explaining the various flat forms and spatial structures in the clothing and accessories of Gandrung dancers.	Students are introduced to the basics of geometry of measurement and its transformations. Students are given pieces of a picture and then group similar parts into flat shapes (geometry).	Students mention it verbally and make notes/lists on the worksheet ; students can be culturally literate.
Model For (Building knowledge by connecting the concepts of accessories and geometry)	Investigating the position of objects relative to other objects from a mathematical perspective on culture.	Students discuss by noting down the names of the clothing and accessories of the Gandrung dancers.	Students can find each shape in Gandrung's clothing and accessories using geometric concepts.
Official (Compile and complete LKPD properly and correctly)	Determining the vertex angles of a plane figure using a protractor	Students can determine various appropriate flat shapes using concrete objects.	Students can investigate and connect things that fall under the topic of geometry.

The following compares HLT 1 and HLT 2, which have been revised and adjusted to the conditions during field observations. There are differences between the two. Researchers view this as a challenge that must be resolved immediately to produce a reasonable and implementable hypothesis, as we know that in planning learning, an educator plays an important role in planning, implementing, and evaluating learning activities (Lestari et al., 2020).

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Table 2. Learning Trajectory Hypothesis Analysis (HLT 2)

Activity	Learning objectives	Activity Description	Alleged Student Thinking
Situational (Concrete image presentation)	Identifying geometric shapes through culture	Students observe the images presented and think about the surrounding culture.	Students listen and think and mention examples of culture.
Model From (Note down important parts that students find interesting)	Describes various flat shapes and spatial shapes	Students write down things they find interesting. Students note down any shapes seen in the picture.	Students mention it verbally and make notes/lists on the worksheet; students are able to be culturally literate.
Model For (Group the parts of the image according to their geometric shape and position)	Investigating the position of objects relative to other objects from a mathematical perspective on culture.	Students demonstrate with body movements as an illustration of the concept of simple reflection. Students group similar Gandrung fashion accessories based on the concept of flat shapes/geometric transformations.	Students can show and think about the meaning of the demonstrated learning topic. Students can find each shape on Gandrung's clothes and accessories using the concept of geometry.
Official (Building Geometry & measurement knowledge)	Summarizing various types of flat forms and building spaces through culture	Students complete the worksheet . Students summarize various examples of plane figures and geometric transformation concepts. Students can determine various types of plane figures that are appropriate through concrete objects such as Gandrung clothing and accessories.	Students can investigate and connect things that are included in the geometry topic; students can work on worksheets properly and correctly.

Results and Discussion

The study's results showed that in the Cycle I trial, the designed HLT could not provide maximum results. Then, based on the results of the Cycle II trial, it can be concluded that the revised learning trajectory hypothesis is by the expected learning objectives. Students can convey their thoughts in the opinion section in the LKS; students can remember culture by completing each part of clothing and accessories that have blank dots; students have been able to reach the formal stage by the learning outcomes designed with the RME iceberg theory, This is in line with the philosophy of Realistic Mathematics Education (RME) in Frudenthal's interpretation where mathematical material is a human activity so that educators are able to develop meaningful learning and involve students actively and realistically through Ethnomathematics. Students can understand a concept because they learn activities that activate motor skills, creativity, and fast thinking. Although there are a few obstacles, this is not a problem during the research process in Cycle II.

Discussion

This study focuses on developing HLT and exploring the hypothesized learning trajectory with the actual one. The analysis was conducted by observing student behaviour when implementing HLT during learning and student work results through worksheets. The cultural topic raised was Gandrung. Gandrung is a dance that is usually performed at opening ceremonies. What can be learned from "Gandrung" is a variety of attractive clothing and accessories. The fashion design motifs are very harmonious, which can be studied from an

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ethnosemiotic perspective, and some things can be studied from a mathematical perspective. The stages carried out in the study were adjusted into several stages based on the characteristics and principles of RME learning, including understanding contextual problems, describing contextual problems, solving problems, combining and discussing, and finally concluding (Ulfah et al., 2020).

Design Preparation

In the initial stage, the HLT and LKS designs were prepared according to the Learning Outcome analysis or KD appropriate for the lower grade level. In the HLT 1 design, discovery was made regarding the occurrence of ALT 1 so that HLT 2 was produced, which was improved by considering all aspects and factors during the activity. Based on the results of the Cycle I observation carried out at SDN Gading 1 Surabaya, the research subjects of grade II students totalled six students with different categories of student ability levels. The data on student ability levels consisted of 2 high-ability students, 2 medium-ability students, and 2 low-ability students. Each trial was conducted in small groups and large groups. The design was a narrative to stimulate students' interest in literacy and numeracy (Widiantari et al., 2022). The LKS section invites students to remember and understand each part of the gendering dancer's clothing and accessories. Then, a worksheet was designed that emphasized motor activities such as cutting and pasting.

Design Experiment

From the HLT 1 design and trial using LKS in Cycle I with research subjects of 6 grade II students of SDN Gading 1 Surabaya, the following ALT 1 was produced.

Table 3. Actual Learning Trajectory Analysis (ALT 1)

Activity	Student Thinking Hypothesis	(Actual) stages of student thinking and learning
Situational (Concrete image presentation)	Students listen, think, and mention examples of culture.	Students still need to show relevance to the learning topic. Students' focus is still divided.
Model From (Note down important parts that students find interesting)	Students mention it verbally and make notes/lists on the worksheet; students can be culturally literate.	Students still need cultural literacy, but they can mention learning topics orally.
Model For (Building knowledge by connecting the concepts of accessories and geometry)	Students can find each shape in Gandrung's clothes and accessories using geometric concepts.	Students investigate and search for each question on the worksheet.
Official (Compile and complete LKPD properly and correctly)	Students can investigate and connect things that fall under the topic of geometry.	Students work on LKPD with two groups of students; group 1 can explain briefly orally, and the second group still needs to reach the formal thinking stage.

From ALT 1, improvements and revisions need to be made to HLT 1 so that in the Cycle I trial, students still cannot connect and have not reached the stage of thinking that is in accordance with the hypothesis. Therefore, improvements need to be made to obtain a learning design useful for improving numeracy literacy and critical thinking skills (Susanto & Hartati, 2022). Then, from here, the Cycle II trial stage was carried out with 22 students as research subjects at SDN Lidah Kulon 3. Students worked on individual sheets, then worked on LKS in pairs, and finally, students were divided into several large groups to work on motor activities on LKS.

DOI: 10.31004/obsesi.v8i5.5846

From the HLT 2 design that was created, ALT 2 was produced as follows:

Table 4. Actual Learning Trajectory Analysis (ALT 2)

Activity	Student Thinking Hypothesis	(Actual) stages of student thinking and learning
Situational (Concrete image presentation)	Students listen and think and mention examples of culture.	Students demonstrate behavior that is not ready to learn but can still be addressed. Students can mention examples of culture.
Model From (Note down important parts that students find interesting)	Students mention it verbally and make notes/lists on the worksheet ; students are able to be culturally literate.	Students can note and verbally mention the parts of the fashion that they find interesting.
Model For (Group the parts of the image according to their geometric shape and position)	Students can show and think about the meaning of the demonstrated learning topic. Students can find each shape on Gandrung's clothes and accessories using the concept of geometry.	Students search and match each part or shape of Gandrung clothing and accessories that match geometry and transformation. However, some students still need to reach the model thinking stage.
Official (Building Geometry & measurement knowledge)	Students can investigate and connect things included in geometry topics and complete worksheets properly and correctly.	Students can relate things included in the geometry topic and provide a short oral explanation.

The revised worksheet was used as follows from the second cycle of trials conducted in this study.

Figure 2. Ethnomathematics worksheet cycle II
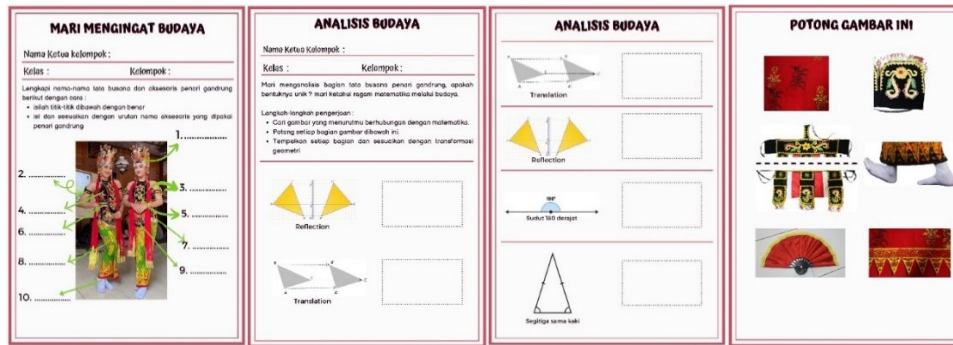
Figure 3. Ethnomathematics worksheet cycle II

Retrospective Analysis

Cycle I

This Initial Cycle analyzes the series of activities that have been implemented, trials are carried out as many as 2 cycles which aim to find a new theory that is in accordance with what is expected in the learning alleyway (Marande & Adha Diana, 2022). The experimental design in Cycle I with a flow of group activities in pairs and groups in the second stage, each group consisting of 3 people. However, in the early stages, the students' conditions still need to be more conducive and the students' focus is slightly divided, resulting in difficulties in learning (Susilo & Sutarto, n.d.). When asked about culture, they still cannot mention it. This means that students still need more cultural literacy around them. In fact, in Indonesia we should be more familiar with regional culture so that it is not eroded by time.

Then, the educator introduced Banyuwangi culture by providing several examples of picture pieces. Students were given stimulus to be active and think critically about the concrete examples of culture presented. The educator introduced basic geometry of measurement through the costumes and accessories of gendering dancers. The research subjects looked enthusiastic when learning things they were not familiar with; they thought about culture and were able to verbally mention the parts of the accessories contained in the power point material that was displayed. Students were connected with general knowledge about their regional culture, ranging from dance, food, nature tourism, culinary, and so on.

Figure 4. Results of group student worksheet work

Dialogue 2

Teacher : "If you look at this picture, what is the name of this compulsive part?"
Student 2 : "Cloth."
Student 3 : "sewing"
Teacher : "Okay, little girl. Then, take a good look at the bottom of this crazy girl. What does it look like?"
Student 1 : "Like a sharp point"
Student 4 : "Similar to the taper of a tumpeng."
Teacher : "Yes, why is the shape like a pointed cone-shaped rice cone? Come on, think about it again. This shape is horizontal. Which flat shape is it?"
Student 5 : "Triangle shape"
Teacher : "Yes, good."

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The way students spontaneously think about the shape of objects and remember them is similar to the examples presented. From here, we can find out the stages of students' thinking through their verbal delivery. In addition, what teachers need to know about teaching geometry is that educators must help develop students' spatial awareness by using activities that provoke students to think (Kennedy et al, 2008).

Figure 5. Otto/Oncer

Dialogue 3

Teacher : "Look at the shape of Otto/Oncer's accessories. If you look closely, what does it look like?"
Student 6 : "Like flat"
Teacher : "Yes, it's roughly flat, right?"
Student 5 : "Flat box"
Teacher : "Why is it square?"
Student 5 : "Because there are four lines, namely right, left, top, and bottom."
Teacher : "Yes, what do you think this plane shape is called?"
Student 2 : "square"

From the dialogue activities that have been carried out, it can be seen that students can think about and mention the forms that exist in the gendering clothing and accessories; this shows that the RME method is known to affect students' mathematical abilities (Juandi et al., 2022). In the activities carried out when implementing HLT 1 and producing ALT 1, there were obstacles such as children needing to focus more on learning; it was found that students wanted to avoid mingling with their group mates and seemed picky. Finally, it was decided to stay together according to the selected group. The student group categories are as follows: Group 1 is in the ability category (high, medium, medium), while Group 2 is in the ability category (high, low, low). When working in groups, students conduct investigations by connecting everything related to the learning topic, especially geometry and measurement. The results obtained for Group 1 were rather difficult, but they could still be done well, and cooperation between members was very good. Meanwhile, Group 2 experienced difficulties and needed to be more organized in their work, were less compact in their work, and needed better coordination between members; sometimes there was conflict between group members, and educators tried to provide understanding and direct students to work together in a team. In the pair group activity, the students obtained the following worksheets: there are three part 1 sheet with categories, and there are three groups, each with two members.

the Cycle I LKS work showed that students could remember the culture but needed help to understand each part of the culture. Then, the LKS part 2 was worked on with categories divided into two groups of 3 people each. In LKS group 1, students were able to construct their thinking skills in grouping the geometric parts found in the gendering dancer's clothing accessories by completing the LKS ; this is in line with PMRI which aims to improve the critical thinking skills of elementary school students (Nurmalita & Hardjono, 2020). In group 2, the LKS still could not understand the concept, and there were errors in the work. This is caused by several factors: lack of cooperation between teams, students who tend to have a kinesthetic learning style and are very active and need more focus during learning.

DOI: 10.31004/obsesi.v8i5.5846

Figure 6. Result of student worksheet for Cycle I (group 1)

At the formal stage of compiling and completing the LKS , students in group 1 were able to mention and briefly explain the results of their work on the LKS . This proves that the cognitive abilities of elementary school students need to be honed through a realistic mathematical approach to improve cognitive abilities and motivate students to be actively involved in learning (Irdawati et al., 2019). Meanwhile, students in group 2 still need clarification and delivery of their work results. So for the Cycle I trial it was found that the designed LKS had not been able to provide maximum results.

Cycle II

From the results of the implementation of HLT 1 to obtain the Actual Learning Trajectory 1 stage, the researcher made revisions and improvements for the implementation of HLT 2 so that ALT 2 was obtained as follows: (1) individual work on a total of 22 research subjects at SDN Lidah Kulon 3; Then it was found that around 82% of students were able to convey their thoughts in the opinion section of the LKS , 14% of students were not yet able to convey their opinions and were still fixated on seeing their friends' answers, and 4% of students had not reached the stage of thinking to write their opinions on the LKS . (2) in the paired LKS , 64% of students showed that they could remember culture by completing each part of clothing and accessories that had blank dots, and the rest of the total research subjects showed that at least 36% of students were still unable to remember culture well. Related and still need help to answer correctly. (3) In the LKS work session, students worked in groups , one group consisted of 5-6 people; The results of the study showed that group 1 obtained 3 points, group 2 obtained 5 points, group 3 obtained 4 points, and group 4 obtained 2 points. These points are temporary because they can change if adjustments are made to the series of activity processes. From the sequence of understanding that can be achieved by students in each group, the sequence of understanding from good to formal stages starts from group 2, group 3, group 1, and finally group 4.

In LKS group 1, students still need to build their knowledge, and the grouping of answers still needs to be precise. This is caused by several internal and external factors, such as students are less focused during learning so that students' absorption of the material is still low, students are less able to solve conceptual problems, and there are external influences between students. The students' learning styles are not based on learning activities. Students need more interest in learning mathematics (Hidayah et al., 2020). In addition, it can be seen from the affective aspect that students have unstable emotions and are often angry, which has an impact on other friends ; in addition, it can be seen from the psychomotor aspect where the health condition of students is related to vision and hearing, and from the results of research observations when students experience poor health conditions (Clark & Stansfeld, 2007).

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External factors, such as noise, cause students to lack concentration (Hidayah et al., 2020). In addition, during the learning process, there are differences of opinion between students and lack of mutual understanding, which has an impact on the work of LKS . When student A wants to answer correctly, student B has an opinion with an inaccurate answer, and several other students follow student B's reference.

Figure 7. Result of student worksheet for Cycle II (group 2)

When working on group 2 worksheets, they can organize and build their understanding of the concept of geometry learning. To reach the formal learning stage, students collaborate between teams to solve conceptual problems, and individuals in the problem-solving process must have critical thinking skills (Hikayat et al., 2020). Student cooperative interaction ensures that the results of the worksheet can be done well and correctly. Students in group 2 work by grouping several appropriate images and matching columns on the question sheet; they fill in and try to connect the pattern of image pieces with existing geometry concepts; researchers realize that the learning achievement material taken is a bit heavy for class students. However, as a start, investment in understanding concepts at an advanced level must at least be introduced from an early age to strengthen students' basic understanding. In the conversation carried out by students and educators during the teaching and learning activities as follows, asking the subjects of group 2 and group 3 .
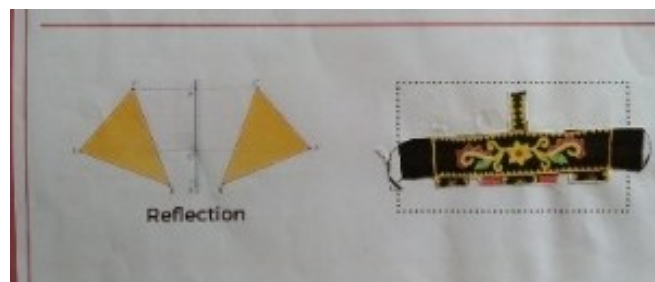
Figure 8. Result of student worksheet for Cycle II (group 2)

Dialogue 5

Teacher: "Why did you put this picture in the reflection column?"
Student: "Because I think it's interesting and suitable."
Teacher: "Why does this fit?"
Student: "The image appears to be divided into two, right and left."
Teacher: "Why is it divided into two, what is it like?"
Student: "Like when you look in the mirror."
Teacher: "Why? What's wrong when you look in the mirror?"
Student: "There are two of us; one is in the mirror."
Teacher: "Aren't our shapes and forms the same as those in the mirror?"

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Student: "Same"
Teacher: "Then why is it the same?"
Student: "Because the picture is the same, it does not change."

Realistic refers to teachers asking students questions they can think of, followed by students solving mathematical problems. This builds students' cognition at each stage of creative thinking (Laurens et al., 2018). The structure of intellectual abilities is systematically considered to stimulate creative thinking and student achievement.
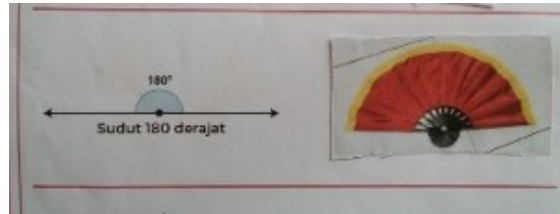
Figure 9. Result of student worksheet for Cycle II (group 3)

Dialogue 6
Teacher: "Why did you put a picture of a fan in this column?"
Student: "Because it looks like a circle."
Teacher: "Which part is shaped like a circle?"
Student: "Bottom fan part"
Teacher: "Then, when the fan is opened/stretched, what does it look like?"
Student: "Like round"
Teacher: "Is the shape round when the fan is opened wide?"
Student: "No."
Teacher: "Then what does a flat plane look like?"
Student: "It's off like a curved ruler."
Teacher: "Curved ruler?"
Student: "similar to miss's bow"
Teacher: "So the fan and the bow have similar shapes?"
Student: "Yes, ma'am"
Teacher: "Then what does it mean to enter a flat plane?"
Student: "Circle but half"
Teacher: "What is a flat shape?"
Student: "Semicircle"

The series of activities carried out and the focus of the discussion are by the RME philosophy, namely human activity (Indriani & Julie, 2017).
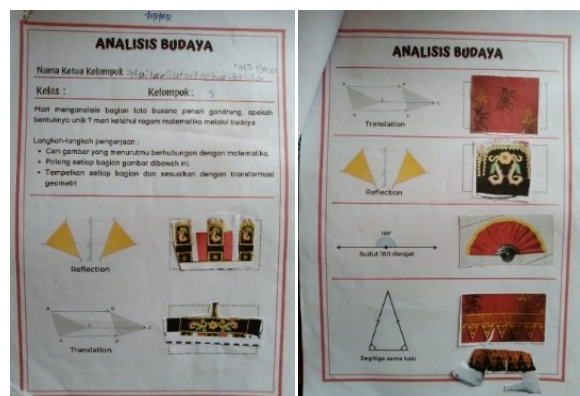
Figure 10. Result of student worksheet for Cycle II (group 3)

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The work on the LKS carried out by students in group 3 was quite good; this shows that students have been able to reach the formal stage by the learning outcomes designed with the RME iceberg theory; although there were a few obstacles, this was not a problem during the research process in Cycle II. Similar to group 1, in group 4 there was also an error in the placement of the picture pieces, which did not match the contents of the column. External factors such as a less conducive classroom environment and students' affective aspects influenced the work on the LKS. Based on the Cycle II trial results, the revised learning trajectory hypothesis was in accordance with the expected learning objectives.

From the experiments conducted in two-cycle stages, HLT 3 was produced as follows:

Table 5. Learning Trajectory Hypothesis (HLT 3)

Activity	Learning objectives	Activity Description	Alleged Student Thinking
Situational (Presentation using concrete images and natural objects)	Identifying geometric shapes through natural objects.	Students observe the natural objects presented and think about the surrounding culture.	Students listen and think and mention examples of culture.
Model From (Refer back to the important parts that students found interesting)	Describes various flat shapes and spatial shapes	Students note down what shapes are visible in the picture.	Students mention it verbally and make notes/lists on the worksheet ; students can be culturally literate.
Model For (Group the parts of the image according to their geometric shape and position)	Investigating the position of objects relative to other objects from a mathematical perspective on culture.	Students demonstrate with body movements as an illustration of the concept of simple reflection. Students group similar Gandrung fashion accessories based on the concept of flat shapes/geometric transformations.	Students can show and think about the meaning of the demonstrated learning topic. Students can find each shape on Gandrung's clothes and accessories using the concept of geometry.
Official (Building Geometry & measurement knowledge)	Summarizing various types of flat forms and building spaces through culture	Students complete the worksheet . Students summarize various examples of plane figures and geometric transformation concepts. Students can determine various types of plane figures that are appropriate through concrete objects such as Gandrung fashion accessories.	Students can investigate and connect things included in geometry topics and complete worksheets properly and correctly.

Despite facing obstacles such as a less conducive classroom environment and affective aspects that influence students' work on LKS, researchers try to regulate students' focus with hand movement games and light icebreakers.

Conclusion

The study results that students went through to understand the concept of geometry and measurement showed that learning through Ethnomathematics of fashion design and fashion accessories can trigger learning trajectories. The Cycle I trial found that the designed HLT could not provide maximum results. Then, based on the results of the Cycle II trial, it can be concluded that the revised learning trajectory hypothesis is to the expected learning objectives. Students can convey their thoughts in the opinion section in the LKS, considering the culture, by completing each part of the clothing and accessories with blank dots. This aligns with the philosophy of Realistic Mathematics Education (RME) in Frudenthal's interpretation, which states that mathematics material is a human activity. Students can also understand a concept because they are involved in learning activities that activate motor skills, creativity, and fast thinking. Through the learning stages, namely observing the concrete parts of the image, paying attention to interesting patterns/decorations, and aligning the parts of the image, students can conclude the results of the formation of the concept of flat plane geometry and its transformation in a simple way. Although there were a few obstacles between students during the study, from one stage to the students reaching the formal stage, it went well. Students can understand and work on the worksheets correctly so that understanding the concept built through the RME iceberg thinking stage can be implemented in teaching and learning activities at school. Recommendations for further research can develop different multimedia that is more interesting, especially for early-grade students; teachers can also apply Ethnomathematics-based learning so that students can be more familiar with local culture.

References

Ambrosio, UD (1985). Etnomatematika dan Tempatnya dalam Sejarah dan Pedagogi Matematika.

Alamsyah, N., Hanifah, & Muchlis, E. (2021). Pengembangan Lkpd Menggunakan Pendekatan Pmri Berbasis Pendidikan Karakter Pada Materi Segitiga Dan Segiempat Di Kelas Vii Smp Negeri 15 Kota Bengkulu. *Jurnal Penelitian Pembelajaran Matematika Sekolah, 5 (JP2MS),* 158–169. https://doi.org/10.33369/jp2ms.v.ii.158-169

Ardiyani, SM, & Gunarhadi, R. (2018). Pendidikan Matematika Realistis Dalam Pembelajaran Koperasi Ditinjau Dari Aktivitas Belajar. *Jurnal Pendidikan Matematika*, 9(2), 301–310.

Basuki, WA, & Wijaya, A. (2019). Lembar kerja siswa berbasis pendidikan matematika realistik: Bagaimana pengaruhnya terhadap kemampuan penalaran. *Jurnal Fisika: Conference Series*, 1157(2). https://doi.org/10.1088/1742-6596/1157/2/022130

Fauzan, A., Yerizon, Y., Tasman, F., & Yolanda, RN (2020). Pengembangan Teori Pembelajaran Lokal Pada Topik Pembagian dengan Pendekatan Matematika Realistik. *Jurnal Eksakta Pendidikan (JEP),* 4(1), 01. https://doi.org/10.24036/jep/vol4-iss1/417

Febri Andarini, F., Anka Monalisa, L., Sugeng Pambudi, D., Yudianto, E. (2019). *Etnomatematika Pada Alat Musik Tradisional Banyuwangi Sebagai Bahan Ajar Siswa*. Kadikma, 10(1), 45-55. https://doi.org/10.19184/kdma.v10i1.11724

Gravemeijer, K. (2004). Teori Pembelajaran Lokal sebagai Sarana Pendukung Guru dalam Pendidikan Matematika Reformasi. *Pemikiran dan Pembelajaran Matematika*, 6(2), 105–128. https://doi.org/10.1207/s15327833mtl0602_3

Hidayah, N., Arief Budiman, M., Cahyadi, F. (2020). Analisis membantu Siswa Kelas V Dalam Memecahkan Masalah Matematika Pada Materi Operasi Hitung Pecahan. *Thinking Skills and Creativity Journal*, 3(1), 46–51. https://doi.org/10.23887/tscj.v3i1.29252

Hikayat, C., Suparman, Hairun, Y., & Suharna, H. (2020). Desain pendekatan pendidikan matematika realistik untuk meningkatkan keterampilan berpikir kritis. *Jurnal Riset Pendidikan Universal*, 8(6), 2232–2244. https://doi.org/10.13189/ujer.2020.080606

Indriani, N., & Julie, H. (2017). *Mengembangkan lintasan pembelajaran pada keliling sepeda dengan pendidikan matematika realistik (RME)*. Prosiding Konferensi AIP, 1868.

https://doi.org/10.1063/1.4995149

Irdawati, A., Marlina, R., Marlina, & Murni, I. (2019). Pendekatan Realistic Mathematics Education (RME) untuk Meningkatkan Kognisi Matematis Siswa Sekolah Dasar. *Jurnal Fisika: Conference Series*, 1387(1). https://doi.org/10.1088/1742-6596/1387/1/012140

Juandi, D., Kusumah, YS, & Tamur, M. (2022). Meta-Analisis pendekatan pendidikan matematika realistik dalam dua dekade terakhir. *Jurnal Pembelajaran Internasional*, 15(1), 381–400. https://doi.org/10.29333/iji.2022.15122a

Kamsurya, R. (2019). Desain Penelitian: Penerapan Pendekatan PMRI Konsep Luas Permukaan dan Volum Kerucut untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis. *GAUSS: Jurnal Pendidikan Matematika*, 2(1), 56. https://doi.org/10.30656/gauss.v2i1.1386

Lestari, RH, Sumitra, A., Nurunnisa, R., & Fitriawati, M. (2020). Perancangan Perencanaan Pembelajaran Usia Anak Dini Melalui Sistem Informasi Berbasis Website. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, 5(2), 1396 – 1408. https://doi.org/10.31004/obsesi.v5i2.770

Marande, GMS, & Adha Diana, H. (2022). Penelitian Desain : Pengembangan Lintasan Belajar Dalam Pembelajaran Matematika Realistik Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis. *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika*, 8(1), 31. https://doi.org/10.24853/fbc.8.1.31-46

Nuraida, I., & Amam, A. (2019). *Trajektori Pembelajaran Hipotetik Dalam Pendidikan Matematika Realistik Untuk Meningkatkan Komunikasi Matematika Siswa Smp*. *Jurnal Infinity*, 8(2), 247–258. https://doi.org/10.22460/infinity.v8i2.p247-258

Nurmalita, R., & Hardjono, N. (2020). Efektivitas Penggunaaan Pendekatan Pendidikan Matematika Realistik (PMR) Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *Jurnal Pendidikan Dan Konseling*, 2, 47–53. https://journal.universitaspahlawan.ac.id/index.php/jpdk/article/view/543

Putri, D. P., Manfaat, B., Haqq, A. A. (2020). Desain didaktis pembelajaran matematika untuk mengatasi kesulitan belajar pada materi matriks. *Jurnal Analisa.* https://doi.org/10.15575/ja.v6i1.5694

Putu Wulan Pratami Dewi, N., & Ngurah Sastra Agustika, G. (2020). Efektivitas Pembelajaran Matematika Melalui Pendekatan PMRI Terhadap Kompetensi Pengetahuan Matematika. *Jurnal Penelitian Dan Pengembangan Pendidikan*, 4(2), 204–214. https://doi.org/10.23887/jppp.v4i2.26781

Rachmat, NA, & Sumiati, DT. (2016). Peningkatan Kemampuan Mengenal Bentuk Geometri Pada Anak Usia Dini Mellui Permainan Mencari Harta Karun. *Jurnal Pendidikan Ke SD an, 11(1).* https://ejournal.upi.edu/index.php/MetodikDidaktik/article/view/3787/2701

Safaridha, E. (2014). Desain Riset Pembelajaran Perbandingan Pada Aktivitas Pengukuran. *JPM IAIN Antasari*, 1, 61–72. https://jurnal.uin-antasari.ac.id/index.php/jpm/article/view/1163

Salasari, K. (2019). *Eksplorasi Etnomatematika Pada Batik Gajah Oling*. https://repository.unej.ac.id/handle/123456789/99984

Septiari, TP (2018). Penanaman Konsep Pada Pembelajaran Matematika Materi Geometri Kelas V di SDN PATIANROWO 2. *JPGSD*, 06, 1096–1105. https://ejournal.unesa.ac.id/index.php/jurnal-penelitian-pgsd/article/view/23931

Susanto, N., & Hartati, S. (2022). Desain Pembelajaran Pemecahan Masalah Untuk Meningkatkan Literasi Numerasi dan Karakter Berpikir Kritis Siswa SD. *CEJou*, 3. https://ejournal.unupasuruan.ac.id/index.php/cejou/article/view/93

Trung, NT, Thao, TP, & Trung, T. (2019). Pendidikan matematika realistik (RME) dan situasi didaktis dalam matematika (DSM) dalam konteks reformasi pendidikan di Vietnam. *Jurnal Fisika: Seri Konferensi*, 1340(1). https://doi.org/10.1088/1742-6596/1340/1/012032

Ulfah, AS, Yerizon, Y., & Arnawa, IM (2020). Penelitian Pendahuluan Pengembangan Perangkat Pembelajaran Matematika Berbasis Realistic Mathematics Education (RME). *Jurnal Fisika: Conference Series,* 1554(1). https://doi.org/10.1088/1742-6596/1554/1/012027

Warsito, Nuraini, Y., Sukirwan, & Muhtadi, D. (2019). Desain pembelajaran pecahan dengan pendidikan matematika realistik di sekolah dasar. *Jurnal Fisika: Conference Series*, 1188(1). https://doi.org/10.1088/1742-6596/1188/1/012110

Widiantari, NKK, Suparta, IN, & Sariyasa, S. (2022). Meningkatkan Literasi Numerasi dan Pendidikan Karakter dengan E-Modul Bermuatan Etnomatematika di Era Pandemi COVID-19. *JIPM (Jurnal Ilmiah Pendidikan Matematika),* 10(2), 331. https://doi.org/10.25273/jipm.v10i2.10218

Winanto, A. (2022). Upaya Guru dalam Meningkatkan Pemahaman Peserta Didik tentang Materi Transformasi dengan Menguatkan Materi Prasyarat pada Mata Pelajaran Matematika. *Jurnal Inovasi Media Pengajaran dan Pembelajaran*, 3(1), 1–6. https://ejournal.sembilanpemuda.id/index.php/jitim/article/view/306